

AUSTRALIAN *TERMITIDÆ*.

PART II.

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(PLATES XXXV.-XXXVI.)

CLASSIFICATION.

In dealing with the insects in this remarkable family, we are met with the difficulty that, while standing alone, in several respects they combine the characteristics of two distinct orders; and though classified by most of our leading entomologists among the Neuroptera or Pseudo-Neuroptera, there are almost as valid reasons for placing them in the Orthoptera, while in their social habits they conform to the ants and bees among the Hymenoptera. It is well known that the termites come from a very ancient stock, a great number of species having been found in the fossil state in Europe and America. Brauer* considers that they are highly modified forms of a type which departed little from the ancestral simple Orthoptera.

In working out the development of a species from Jamaica (*Eutermes rippertii*) Dr. Knower, in a preliminary abstract, says† : "I think that the Termite and those Orthoptera having a superficial embryo beginning in a disc which must elongate considerably to attain the definite number of segments, have most nearly adhered to the typical method of development for arthropods, and probably best represent the development of the ancestral insects."

* F. Brauer, "Systematisch-zoologische Studien." Sitzungsberichte d. Kaiserlichen Akad. d. Wissenschaften, Wien. Band xci. 1885.

† H. Mc E. Knower, "The Development of the Termite." Johns Hopkins University Circulars. Vol. xv. No. 126, 1896, p. 87.

Dr. Packard, who has given the termites a considerable amount of attention,* in his *Entomology for Beginners* has erected the Order *Platyptera* (insects with wings flat upon the back) in which he places them with the *Psocidae* and *Perlidae*; but they seem to have little affinity in other respects with the stone-flies and the book-louse.

If the wings and the tip of the abdomen be removed from one of the larger termites it might be very easily mistaken for an earwig; and one of our greatest authorities† on the Neuroptera actually described a supposed "wingless termite" from Japan under the name of *Hodotermes japonicus*, but in the following volume appeared a note from the author, stating that upon comparison with a Japanese *Forficula* he had found that the supposed termite proved to be a damaged earwig. Dr. Hagen also remarks that in his opinion "the three families *Termitina*, *Blattina*, and *Forficulina* are co-ordinated, and very nearly allied" (p. 139).

If the wings of the larger termites are compared with those of several of our cockroaches, it will be found that there is a marked resemblance in the form of the parallel nervures with the recurrent forks without any true cross veins running to the extremities of the wings in the cockroaches, while in the termites they generally turn downward, but this is not always the case, for in the wings of a very large termite from Northern Australia (for which I propose the name *Mastotermes darwiniensis*) and some species of *Calotermes*, the parallel veins are stout and thick, forking again and again till they run out at the tips, while in *Mastotermes* the fore wings have several more stout nervures than the hind pair.

Termites do not closely resemble any of the lace-winged insects in their perfect state; their metamorphosis is incomplete, as they pass from the egg to the active little larvæ with perfect propor-

* Notes on the external anatomy will be found in Third Report U.S. Entom. Commission, 1883, pp. 326-329.

† Dr. Hagen, Proc. Bost. Soc. of Nat. History. xi. p. 399, 1868.

tions, increasing in size with each successive moult, but always little termites from birth, even the soldiers in some species showing the elongated form of the head long before they reach maturity.

I consider they have a greater affinity to the Orthoptera than the Neuroptera, and, without going into the anatomy of the family, which I leave to an abler pen, would suggest that they form a natural link between the two orders, coming after the *Forficularide* and *Blattide*.

I have followed Dr. Hagen in the terms used for the venation of the wings and general structure. I try also to describe each species with its habits and life history when obtainable, so that our coming entomologists will be able to recognise the species without much difficulty. In a few instances I have described winged forms only, in the hope of afterwards getting the other forms to complete their life-histories. I have a great number of winged specimens evidently belonging to different species that I retain till I have completed the series for the various localities from which they were taken.

Family TERMITIDÆ.

Perfect insects slender, with a rounded head, and large compound eyes more or less projecting on the sides of the head; ocelli two or in some groups wanting; antennæ long and slender, consisting of from 9-31 or more moniliform joints; jaws stout and short, with a number of pointed or angular teeth covered from above with a large rounded labrum.

The head is attached to the thorax by two very large sclerites placed on either side of the under portion of the head. Thorax moderately large, with the prothorax very distinct and characteristic in the different genera, sometimes heart-shaped, lobed on either side, or saddle-shaped; meso- and metathorax each bearing a pair of flat wings of uniform size resting over each other, and extending beyond the tip of the abdomen. Their venation is simple, consisting of four main parallel nervures, termed the costal, subcostal, median and submedian, which send out a number of

short concave or sloping transverse veinlets very variable in number and disposition. The remarkable transverse suture near the base of the wings causes them to drop off at the slightest obstruction, leaving behind attached to the thorax a small slender flap (which I have termed the scapular shield). In the legs the coxæ are large, with a transverse trochanter at the base, to which the thighs are attached and not to the coxæ; the femora are generally stout and short; the tibiæ slender and cylindrical, with two or more stout spines at the tip; the tarsi consist of four joints, the first three round, with the terminal one slender, armed with sharp curved claws, at the base of which there is sometimes a plantula.

The abdomen consists of ten segments, forming an elongated rounded body with a pair of cerci at the base of the 9th segment, and in many species there are sometimes two other slender jointed appendages known as the anal appendices.

The integument consists of chitinous plates, generally very thin and delicate, but in some of the larger species of considerable strength.

Termites live in social communities, either constructing distinct nests, earthy mounds covering a woody nucleus, known as a Termitarium, or else simple tunnels or galleries under logs, stones, or in the timbers of houses. Each community consists, broadly speaking, of three castes or classes. Firstly, the winged males and females, which are found in great numbers only at certain seasons of the year, but always in the nests in a larval or imperfect form. Secondly, the workers, aborted males and females, wingless, pale yellow, or white, with a large oval body and no very distinctive characters in most species; these do all the work of the nest, building the walls, gnawing out the wood, and looking after the eggs and young larvæ. Thirdly, the soldiers, also aborted males and females, which have the jaws produced into long scissor-like projections, closing over or meeting at the tips like a pair of shears, very constant in form in the different species, and of use in classification.

In the genus *Eutermes* the soldiers (nasuti) have a nose-like process of the head which is hollow, and connected with a large retort-shaped vesicle occupying the upper portion of the head. From it is discharged a thick honey-like fluid, forming a globule at the tip of the snout; and this is used as a means of defence.*

This protective fluid is also made use of among some of the two-jawed soldiers, and when this is the case the opening is above the base of the clypeus, and the ejected fluid is thick and milky.

The abdomen of the soldiers is more slender than that of the workers. Their duties are to protect the workers from any enemies when the walls of the galleries are broken into, and also to direct them at their work.

These are the first three primary forms found in the nest, but there is a great number of secondary ones. First in importance among these is the queen, produced from a winged female fertilised by a male (both of whose wings have either dropped or been pulled off, and who after their flight with the other winged forms) from the parent nest, have been taken care of by some workers who have probably in the first instance found them under a log. After fertilization the body swells out into an immense, white, elongate, cylindrical sac the original chitinous plates of the segments forming black bars across the intersegmental membrane of the abdomen, now consisting of a mass of egg tubes rendering the queen incapable of active locomotion.

Next come the complementary queens, another form of the female termite which seems to have reached a secondary stage, with an enlarged corrugated abdomen, and though not ordinarily egg-producing they are capable of becoming so if required, and appear to be "kept in stock," so to speak, to replace the true queen should she be killed or become incapable, so that egg-production may not be checked. Unlike the queen they are produced direct from the female larvæ, and have no sign of

* H. Mc E. Knowler, "Origin of the Nasutus (Soldier) of *Eutermes*," Johns Hopkins University Circulars. Vol. xiii. No. iii. p. 58, 1894.

rudimentary wings as she has. I have as many as ten supplementary queens taken from a single mound. Müller was the first to notice the forms when working out the life-histories of the termites of Santa Catherina in Brazil*; in one nest he found 31 complementary queens. Besides these there are larvæ in all stages of growth, from minute little creatures just emerged from the eggs to pupæ with the wing-cases extending half way down the back; as well as young workers and soldiers, the latter showing the alteration in the form of the head before the last moult.

Lately near Newcastle when turning over some logs I found a nest of *Eutermes fumigatus*, Brauer, in which the queen was exposed in the centre of the irregular galleries damaged by the removal of the log; and among the Eutermes I found six or seven reddish-brown perfect insects (excepting that they were minus their wings) of some undetermined species of *Calotermes*; these did not seem to be quite at home, but had evidently crawled in under the log for shelter, and thus found their way into the nest.

The family *Termitidæ* has been divided into seven genera, and four subgenera, several comprising both fossil and existing species, others only modern forms, and three fossil species only.

Though a good deal of work has been done by entomologists upon this family it has always been upon different genera. The late Dr. Hagen's Monograph upon the *Termitidæ* is our only guide to the general classification of the family, and this was published nearly 40 years ago. His proposed Monograph upon their anatomy was never published, beyond a short paper on *Eutermes rippertii*.† His classification is chiefly founded upon the structure of the wings, the ocelli, the number of joints of the antennæ, the shape of the prothorax, and the tibial spines.

Following this very natural classification, I have considered his four subgenera as genera, and further grouped them into

* Fritz Müller, "Beiträge zur Kenntniss der Termiten." Jen. Z. Nat. vii. pp. 337, 463.

† Psyche v. pp. 203-S, 1889.

subfamilies based upon the neuration of the wings, also taking into account the habits, and the form of the soldiers, which seem to be very similar in most of the genera I have observed. In the case of the genus *Hodotermes* and the two subgenera *Stolotermes* and *Porotermes* I have been somewhat puzzled. In Hagen's definition of *Hodotermes* he says "ocellis nullis," but in his figure of *H. viator* (Tab. iii. fig. 8) he shows lateral ocelli, and in the Cambridge Natural History, published last year (Vol. v. p. 556), a figure of *Hodotermes mossambicus* is given "after Hagen," in which the lateral ocelli are most distinctly drawn. The only species of this group that I have in my collection is a doubtful species of *Stolotermes ruficeps*, Brauer, which has no ocelli, and among all my Australian specimens I have not yet found any that can be placed in this group, but an allied group for which I propose the name of *Glyptotermitinæ* takes their place in the Australian fauna. I have placed the genus *Rhinotermes* after the *Calotermitinæ* from a careful study of their habits and the robust form of the wing. I was acquainted with a very curious white ant with two very different-looking kinds of soldiers, but of which I had never seen winged forms among the New South Wales specimens; but in a collection from Queensland I found a number of winged specimens that on comparison with a co-type of Brauer's *Rhinotermes intermedius* (for which I am indebted to the Director of the Austrian Museum) turned out to be this species. I also have another species of the genus with identical habits which has been sent to me from Kalgoorlie, West Australia, by my father, with a full account of its habits.

In the term used for the venation of the wings I have followed Hagen. But when using the words "scapular shield," I mean that portion of the wing between the body and the cross suture (the "basal scale" of Scudder); its form and structure appear to be very consistent in the different genera.

Family TERMITIDÆ.

i. Subfamily CALOTERMITINÆ.

Wings robust; scapular shield broad, with five or more branches from the base. Costal and subcostal nervures connected by

sloping cross nervures forming a network of smaller ones at the tip. Fore wings differing from the hind pair in the venation in many species.

1. Genus *MASTOTERMES*, g.n.

Head large, flattened on the summit; eyes large; ocelli small; antennæ 30-jointed; prothorax large, with the sides turned up; scapular shield with more than five branches.

2. Genus *CALOTERMES*, Hagen. (Recent and fossil.)

Head round; eyes large, projecting; ocelli small; antennæ 16-20-jointed; prothorax large and broad.

3. Genus *TERMOPSIS*. (Recent and fossil.)

Head large, broadest behind; eyes small, oval; ocelli wanting; antennæ long, 23-37-jointed; prothorax small, not as wide as the head.

4. Genus *PAROTERMES*. (Fossil.)

Head rather large; eyes small; ocelli wanting; antennæ 20-jointed; prothorax subquadrate, not broader than the head.

5. Genus *HODOTERMES*. (Recent and fossil.)

Head large, circular; eyes small; not projecting, facets coarse; ocelli wanting; antennæ 25-27-jointed; prothorax small, broader than long.

6. Genus *POROTERMES*. (Recent.)

Head small; eyes small, facets fine; ocelli wanting. Venation of the wings very fine.

7. Genus *STOLOTERMES*. (Recent.)

Head large, circular; eyes small, facets coarse; ocelli present; antennæ 12-14-jointed; prothorax heart-shaped.

8. Genus *MIXOTERMES*. (Fossil.)

Founded by Sterzel upon a fossil wing from Lugau. Allied to *Calotermes* (Berichte der Naturwissenschaftlichen Gesellschaft zu Chemnitz. 1878-80).

ii. Subfamily RHINOTERMITINÆ.

Scapular shield broad, slightly convex at the cross suture, with four branches. Costal and subcostal nervures very stout, running to the tip of the wing, and joined at the extremity with short irregular thick nervures; median and submedian nervures slender, with a great number of fine oblique nervures, and all the wing thickly covered with fine furrows.

1. Genus RHINOTERMES. (Recent.)

Head broad; eyes small, projecting and coarsely faceted; ocelli small; antennæ 20-jointed; prothorax not as wide as the head, rounded in front.

iii. Subfamily GLYPTOTERMITINÆ.

Scapular shield slender, angular, with the cross suture transverse, with four or more branches. Costal and subcostal nervures running very close to each other, the latter often merging into the former in the centre; median nervure running through the upper half of the wing, and the submedian about the middle, the latter and the oblique nervures often formed of fine spots or scars.

1. Genus GLYPTOTERMES. (Recent.)

Head broad, rather flat and quadrate; eyes moderately large, slightly projecting, coarsely faceted; ocelli rather large, close to the eyes; prothorax long, broadest and concave in front, rounded on the sides.

2. Genus HETEROTERMES. (Recent.)

Head very large, longer than broad; eyes small, not projecting; ocelli wanting; antennæ 16-jointed; prothorax quadrate, with base and apex arcuate.

iv. Subfamily TERMITINÆ.

Scapular shield angular, slightly rounded above but transverse below, showing four branches. Costal and subcostal nervures running parallel, but widely separated from each other; median

and submedian slender, the former divided into one or more forks at the extremity.

1. Genus *TERMES*. (Recent and fossil.)

Head large, rounded; eyes large, and prominent, finely faceted, ocelli present; antennæ 13-20-jointed; prothorax heart-shaped; flattened, smaller than the head.

2. Genus *EUTERMES*. (Recent and fossil.)

The form of head and thorax very similar to that of *Termes*; wings always dark coloured, with the base of the nervures in the scapular shield not as robust as in the latter. Soldiers always nasuti.

3. Genus *ANOPLOTERMES*. (Recent.)

A genus formed by Müller on the internal anatomy of a *Eutermes* from Brazil (*A. pacificus*). He also places *Eutermes ater*, Hagen, and *E. cingulatus*, Burm., with the new species.

CALOTERMITINÆ.

MASTOTERMES, g.n.

Head large, nearly as broad as long, flattened upon the summit; eyes large, projecting; ocelli prominent; antennæ 30-jointed; clypeus large, labrum rounded at the apex. Prothorax shaped like that of *Calotermes*, except that it is turned up on the outer edges, with the scapular shield as long as the meso- and metathorax. Fore wings differing from the hind pair in venation in having fewer parallel nervures between the costal and subcostal, the upper portion of the wings crossed with stout nervures, with the whole of the wing finely reticulated with smaller veinlets. Tibiæ with four spines at the apex; claws large with a small plantula.

This genus is founded upon a species from Port Darwin, W. Australia, and is allied to *Calotermes*.

MASTOTERMES DARWINIENSIS, n.sp.

(Pl. XXXV. figs. 3-3a.)

Head castaneous, thorax dark ferruginous; legs, under side and abdomen dark brown; antennæ yellow; wings, scapular shield and

nervures ferruginous; the rest yellowish-brown. Length to tip of the wings 16, body 8 lines.

Head large, nearly as broad as long, rounded and broadest behind, rounded on the summit, flattened and rugose in front, truncate across in line with the eyes. Eyes large, circular, projecting, very finely faceted; ocelli large, oval, close to inner margin of the eyes. Antennæ long and slender, 30-jointed, springing from a depression in front of the eyes; 1st joint large, cylindrical, broad at apex; 2nd nearly as thick but shorter; the others moniliform to near the tip where they become more stalked, the last being the smallest. Clypeus arcuate and broad behind the sides forming little angular flanges, with the middle quadrate and lobed in the centre; labrum broader than long, almost quadrate, with the sides rounded and flattened, shell-shaped; palpi long, with the base of each joint white; jaws broad and rounded, with two small angular teeth at the tip, and a flattened untoothed edge to the base slightly hollowed out in the middle. Prothorax as wide as the head, wider than long, concave in front, rotundate, with the sides and apical margin forming a half circle, depressed in the centre, with the edges (particularly on the sides) turned up. Legs short, thighs stout, with the tibiæ covered with fine hairs, and four stout spines at apex; tarsi short, having the terminal joint slender, with four small sharp spines and a small plantula.

Wings large, thrice as long as broad; scapular shield large, cross suture convex, with eight stout parallel nervures branching out of it: venation of the fore and hind wings different. Fore wings with costal nervure slender, running round to tip of wing, receiving four stout parallel nervures merging from the scapular shield, turning up at regular intervals before the middle of the wing into the costal; subcostal branching out into four stout transverse parallel nervures turning up into the costal beyond the tips of the former ones, forming a regular pattern; median nervure closely parallel with the subcostal, bifurcated in a line with the third fork in the subcostal, the two branches running out into a network of finer nervures at the margins; submedian nervure

fine, irregular, running through the middle of the wing, with six short stout oblique nervures at the base, and seven or more slender nervelets running out towards the edge and forming a network all over the wing. Hind wings with only two parallel nervures between the costal and subcostal, one bifurcation less on the subcostal; median forked in the middle of the wing, upper branch bifid at tip, lower one turning downward and again branching; upper one bifid, lower one simple; submedian as in the fore wings, but irregular in the neurulation of the oblique nervelets. Abdomen short, broad, and rounded at the tip, with short cerci; anal appendices small, slender, close together, near the tip of the abdomen.

Hab.—Port Darwin, N.T. (Mr. N. Holtze); Northern Territory (Mr. J. G. O. Tepper).

Among a number of pinned specimens of termites sent to me by Mr. Tepper was a single specimen of this species, which was very noticeable from the network of veins along the costal margin, as well as its large size. During the summer of the following season, Mr. Holtze sent me seven specimens in spirits, taken "flying round the lamp at night" in the Botanic Gardens, Palmerston.

There are two specimens in the Macleay Museum, one of which is labelled Cleveland Bay (Townsville), N.Q., collected, Mr. Masters thinks, by Mr. Spalding; and another from King's Sound, N.W. Australia, taken by myself, flying round the lamp, at a station about 100 miles inland from Derby.

Genus CALOTERMES, Hagen, 1853.

Hagen, Bericht d. K. Akad. Berlin, 1853, p. 480; *Linnaea*,
xii. p. 33.

Head rather small, triangular or rounded; eyes large and projecting from the sides of the head; ocelli small; clypeus small, flattened; labrum small, quadrangular; antennæ as long as the head, 16-20-jointed, antennal cleft small; jaws short, stout and blunt. Prothorax large, as wide or nearly as wide as the head, broader than long, truncate or arcuate in front, with the sides

and apical edges forming a semicircle. Legs stout, the tip of the tibiæ with three or four spines; tarsi with plantula. Wings large, narrow, twice or thrice as long as the body; subcostal narrow, widening out towards the tip and connected to costal by five or six veins, irregular in number, forming a network between the two; median nervure slender, running through the middle of the wing, with irregular cross veinlets, the whole of the outer portion of wing showing an irregular network: scapular shield as long as mesothorax in the fore pair, and about half the length of metathorax in the hind pair. Abdomen small, a little wider than the thorax; cerci stout, short, and jointed.

Soldiers short and stout. Head large, cylindrical, flattened in front and rugged or truncated before the jaws, which are stout and strong, about one-third the length of head, almost straight, flattened towards tips, close at the base, with short stout teeth, irregular on opposite jaws; labrum small, short, and transverse or quadrangular.

These termites do not construct regularly formed nests, but live in small communities in logs, timber, beams of houses or under stones; many nests contain under a hundred individuals, chiefly workers or immature nymphs, and sometimes only half a dozen soldiers, though in others these are more numerous. I have never found a queen among any community of the genus.

Calotermes has a pretty wide distribution, ten species being described from America and the West Indies, one from Europe and the north of Africa, four from Australia and Tasmania, one each from Madiera and the Isle of France, and three from Europe known only as fossils.

There are probably many species of this genus to be found, but from their retiring habits they are seldom met with unless closely looked for.

CALOTERMES CONVEXUS, Walk.

Termes convexus, Walker, Brit. Mus. Cat. Neuroptera, p. 527;
Hagen, Mon. Linnæa, xii. p. 45.

Ferruginous; lower surface, abdomen, antennæ, and feet fulvous, smooth and shining; wings subfuscous. Length of body $1\frac{1}{2}$ lines.

Head elliptical, much longer than broad, scarcely smaller than the thorax. Antennæ shorter than the head, probably 13-jointed. Ocelli close to the eyes. Jaws small, two-toothed, with dark points. Prothorax with an indistinct suture in the centre, much broader than long, concave anteriorly, sides convex, flattened behind; body scarcely longer than the thorax. Legs stout, with the 4th joint of tarsi as long as the first three combined. Wings pale brown, costal and subcostal nervures ferruginous, with about 12 oblique branches; the other nervures very pale and indistinct, with rows of finer ones between them, from the lower side about 12 oblique branches, the wings generally feeble and wrinkled.

Soldier greyish, hairy, shining. Length 3 lines. Head oval, reddish-yellow, flat on the summit, ferruginous in front, longer and broader than the thorax; jaws blackish, robust, almost straight, bent in at the tips and armed with two broad teeth. Antennæ shorter than the head, the extremity of each segment light coloured, shorter towards the tip. Prothorax twice as broad as long, anterior angles concave, sides and posterior angles convex, body club-shaped, broader and longer than the thorax, 3 lines in length.

Worker grey. Head small, with a pitch-coloured spot between the antennæ, the latter almost as long as the head; body almost club-shaped, very much broader and longer than the thorax. Length 3 lines.

Hab.—Tasmania, and Swan River, W.A.

This description is taken from Hagen's Monograph. He says: "In comparison with the type, the somewhat larger *Termes obscurus* from Swan River (long. corp. $2\frac{1}{2}$, exp. alar. 7 lines), is not otherwise different from *T. convexus*. Between the claws is seen a plantula. This species closely resembles *Calotermes improbus*, and whether it should remain separate is a matter for further consideration, though it is much smaller. The workers and soldiers described by Walker (Brit. Mus. Cat. p. 52) as belonging to *Termes australis*, are very probably those of *C. improbus*."

CALOTERMES INSULARIS, White.

Calotermes insularis, White, Voy. Erebus & Terror, Zool. Pl. ii.
(Pl. xxxv. fig. 4.)

General colour bright ferruginous, wings hyaline, nervures light brownish-yellow. Length to tip of wings 11, to the tip of body 5 lines.

Head longer than broad, rounded behind, widest behind the eyes, sloping on sides to apical margin, truncate in front, convex on the summit, sharply sloping down on the forehead. Eyes moderately large, round, coarsely faceted, projecting slightly on the sides; ocelli large, round, contiguous to front of the inner margin of the eyes. Antennæ broken (probably about 20-jointed), springing from a cleft in front of the eyes; joints all particoloured, the apical edges barred with pale yellow; 1st-3rd cylindrical, basal ones largest, 4th orbiculate, the remaining ones turbinate, lightly fringed with hairs. Clypeus wide at base, but very narrow, sloping on the sides to rounded tips at the centre; labrum broad, rounded in front. Prothorax very large, broader than long, deeply concave in front, rotundate and rounded behind, showing faint median suture: meso- and metathorax much narrower. Legs short, thighs broad and rounded; tibiæ short, with three stout spines at apex; terminal joint of the tarsi about as long as the first three combined; plantula and claws large.

Wings very long, four times as long as broad, rather sharp at the tip; scapular shield large, rounded, with the cross suture rounded to subcostal, but transverse below, showing five parallel nervures; subcostal nervures slender, running round the tip, with a stout parallel-oblique nervure branching out of it in the scapular shield, connected with it beyond the scapular shield by two short oblique nervures and joining it again about one-quarter from the base; subcostal nervure running parallel with five stout parallel-oblique nervures turning up into the costal and several smaller ones forming a network between them at the tips; median nervure running close to the subcostal with no upward cross nervure till

near the tip, where several short ones form an irregular network, but having a number of short spine-like nervures along the lower margin; submedian nervure running through the middle of the wing, turning downwards before reaching the tip, with six stout oblique unbranched nervures at the basal portion, and nine fine oblique nervures beyond; the whole wing finely covered with indistinct veinlets giving it a frosted appearance. Abdomen very short and thick, smooth and shining; with the cerci of usual size; anal appendices undistinguishable.

Hab.—Melbourne, Victoria (Mr. Kershaw).

Only one dry pinned specimen, from the National Museum, Melbourne, but very distinct from any of my other species, and remarkable for the very long wings.

CALOTERMES IRREGULARIS, n.sp.

(Pl. xxxv. figs. 1, 1a, 1b).

Head ferruginous; thorax and abdomen ochreous; antennæ, legs and under surface lighter coloured; wings pale ochreous, with the nervures fuscous. Length 8 lines to tip of wings; body $4\frac{1}{2}$ lines.

Head rounded behind, longer than broad, sloping in from the eyes to the clypeus, lightly clothed with a few scattered hairs. Eyes very large, projecting; ocelli large, rounded oval, contiguous to the centre of inner margin of eyes. Antennæ 19-jointed, hirsute; 1st joint large, cylindrical, springing from a shallow antennal cleft below the eyes; 2nd cylindrical, smaller, and half the length; 3rd more rounded at the tip; 4th shortest; 5-12 moniliform, slightly increasing in size toward the extremity; 13-18 longer, turbinate, with the last elongate-oval. Clypeus small, rounded in front, sloping on sides, broadest behind; labrum large, shell-shaped, rounded in front; jaws large, stout, with the apical tooth large, curved inwards, a short conical one below, with two stout angular ones towards the base. Prothorax as broad as the head, slightly concave in front, rounded on the sides, truncate behind, showing a slight median suture; mesothorax narrow, with

rounded base, a slight median suture; metathorax smaller, rounded behind. Legs short, rather hairy; thighs short and stout; tibiæ moderately long, with three short stout reddish spines at the apex; tarsi with the terminal joint not quite twice as long as the three preceding ones combined, tarsal claws long and slender; plantula oval. Wings more than twice as long as wide, broad and rounded at tips; scapular shield long; costal, subcostal and median nervures running parallel to each other at equal distances apart to the tip of the forewing; subcostal with five oblique veins running upwards into costal; median furcate at the tip; submedian nervure slender, with about 13 oblique nervures, the last four furcate; median with a number of short irregular veinlets along the lower edge, and a faint irregular network of nervelets over the whole wing. Hind wing: costal and subcostal nervures running into each other in the middle of wing; median furcate a short distance from shoulder, the upper branch dividing into five oblique veins, turning upwards into the costal; the lower branch running parallel, straight out to extremity of wing: the rest of wing as in fore pair. Abdomen large, smooth, shining, rounded at tip; cerci short, stout and hairy.

Soldier.—Head rufous, jaws black; legs, antennæ, and prothorax pale ochreous; the rest dirty white. Length 6, from tip of jaws to base of head $2\frac{3}{4}$ lines. Head longer than broad, rounded at base, straight on sides, emarginate in front and sloping down behind the clypeus, with a median furrow: clypeus hidden, labrum short, rather broad and almost truncate in front; antennæ as in winged insect, only more slender; jaws very stout and thick, ochreous at base, the rest black, rather straight on sides, meeting at the curved-in tips, with several small teeth along the left jaw and two large angular ones on the right side; thorax and abdomen elongate-oval, nearly as broad as the head, tapering to the rounded tip.

Worker.—Head pale yellow, jaws black, the rest dull white. Length 5 lines. Head nearly spherical; jaws stout, with two sharp-pointed teeth at apex, and angular ones below; clypeus

large, rounded in front, with a dark spot on either side; labrum rather long, narrow and truncate in front and straight on the sides: anal appendices large, at right angles to each other; cerci as in others; body long and cylindrical.

Hab.—Mackay, Queensland. (Mr. G. Turner).

CALOTERMES IMPROBUS, Hagen.

Hagen, Mon. Linnaea, xii. p. 44.

Chestnut brown, head somewhat darker; antennae, legs, and underside bright yellow; head and thorax smooth, not hairy. Length $6\frac{1}{2}$ mm.

Head oblong, quadrangular, almost half as long again as broad, rounded posteriorly. Eyes small, projecting slightly, well in front of head; ocelli large, away from the eyes, a small central mark or false ocellus almost in a line with the hind margin of the eyes. Antennae short and stout, longer than the head, 20-jointed, coalesced, round; first joint larger than the following ones, 4th and last smallest. Labrum short, oblique below the jaws; labial palpi thicker and shorter than in the other species. Prothorax large, broader than the head, rounded and flat, sides turned down in front, concave, rounded posteriorly, the angles rather truncate behind. Scapular shield of forewings large, round and truncate, longer than the mesothorax. Wings wanting. Legs short, with three spines at apex of tibiae; the only existing claw is short, sharp, and curved; if a plantula is present it is not noticeable in this specimen. Body egg-shaped, broad; abdominal appendices very small, two small cerci.

The above description is taken from Hagen's Monograph. He described this species from one imperfect specimen, without wings, and with only one imperfect leg.

Hab.—Tasmania. It does not agree with any of my species from Australia. But in the case of a species known only from a single imperfect individual it would be hard to identify it without a good series of specimens collected in the same locality.

CALOTERMES LONGICEPS, n.sp.

(Pl. XXXV. fig. 7.)

(Immature). Head pale yellow, jaws black, rest of insect dull white. Length 6 lines.

Head spherical, a little longer than broad. Eyes indistinct; ocelli (?). Antennæ 20-jointed; 1st stout, cylindrical; joints 2-7 very short, orbiculate; the rest moniliform, towards the tip becoming broader at apex; the last smaller, elongate-oval. Clypeus truncate behind, rounded in front, narrow: labrum large, convex in front: jaws short and stout, with three teeth above and two angular ones at base. Prothorax as broad as head, slightly concave in front, broadly rounded on sides, and nearly truncated at apex, with a median suture extending through the rest of the thorax; wing covers extend down to the third segment of the abdomen, slender and pointed. Legs rather short; thighs small, slender; tibiæ short and thick, with three stout ferruginous spines at apex; tarsi short, terminal joint large, with plantula and stout claws. Abdomen long, cylindrical, rounded at the tip, with very small anal appendices, and the cerci small and hairy.

Soldier.—Head bright ferruginous, jaws black, the rest light yellowish brown. Length $6\frac{1}{2}$ lines; the head and jaws as long as thorax and abdomen. Head very large, longer than broad, convex above but sloping to base of the jaws, slightly rounded on the sides, and emarginate in front of the antennæ: antennæ very slender, 20-jointed; 1st stout, cylindrical; 2nd smaller; the rest moniliform to the tip: clypeus narrow, truncate behind, rounded in the front; labrum spade-shaped, straight on the sides, rounded in front, and projecting to the base of first large tooth; jaws very stout and large, straight on the sides, curving inwards slightly and meeting at the tips, with three small irregular teeth on the left hand jaw and one large angular one on the opposite side; a slight median and cross suture on head. Prothorax not as wide

as the head, short, concave in front, truncate behind and rounded on the sides: legs short, thighs thick: abdomen short, and very broad in proportion, flattened, anal appendices showing at tip of abdomen, cerci small.

Hab —Sydney, N.S.W. (W. W. Froggatt).

This species lives in dead logs, in small communities of fifty or a hundred, and in several that I have cut out of firewood they have consisted of immature winged ones, with only one soldier, and one or two workers. I have never been able to breed the perfect insects, though a number of them lived for some months in a tin.

CALOTERMES ROBUSTUS, n.sp.

(Pl. xxxv. fig. 8.)

Head and prothorax dark ochreous, the upper surface of the rest of the thorax and abdomen lighter coloured; antennæ, under surface and basal portion of legs light ochreous, with the tibiæ and tarsi slightly ferruginous; wings semi-opaque, with the nervures ferruginous. Length to tip of wings 9; to tip of body $5\frac{1}{2}$ lines.

Head orbiculate, about as long as broad, convex, and rounded on summit. Eyes large, coarsely faceted, projecting; ocelli large, oval, contiguous, and in line with the front of the eyes. Antennæ 19 jointed, long and slender towards the tips, springing from a circular antennal cleft in front of the eyes; 1st and 2nd joints large, cylindrical; 3rd-8th short, moniliform; 9th-12th turbinate; 13th-18th more stalked and elongate; terminal one much smaller, slender, elongate, oval. Clypeus rounded in front, very prominent, divided in the centre by a suture forming two convex lobes; labrum large, rounded in front. Thorax with a fine dark median line running down to apex of metathorax; prothorax much broader than long, as broad as the head, truncate at both sides, slightly depressed in the middle of each, and rotundate on the sides, smooth and shining. Legs rather long, thighs com-

paratively slender, tibiæ short and rather bent, with four stout spines at the apex; tarsi long, claws stout, plantula small.

Wings large, more than thrice as long as broad, rather pointed towards the tips; fore and hind wings differing in the neuration: scapular shield short, rounded, with the cross suture curving round showing the base of the six branching nervures; costal more robust than usual, receiving two stout parallel nervures running out of the scapular shield and sloping up into it; subcostal sending out four other cross nervures sloping into the costal beyond them, and a number of more transverse ones forming numerous short cells towards the tip of the wings; median nervure running close to subcostal and connected with it at irregular intervals by a number of transverse nervures most numerous towards the apex; submedian running through the middle of the wing, with six oblique short thick opaque nervures at base, and five slender nervures branching out, turning downwards and again dividing before reaching the margins; the whole wing thickly reticulated with finer veinlets: hind wing with only one parallel sloping nervure between the costal and subcostal, but connected to the costal with two very short oblique nervures as well as at the tip; subcostal nervure running parallel and sending out three oblique nervures running into the costal, and ending in a regular network at the tip; there is no true median nervure, but a branch emerging from the subcostal, in a line with the base of the 7th oblique nervure of the submedian, takes its place and is connected with short transverse nervures to the tip; the rest of the wing as the forewing. Abdomen elongate, oval, rounded at the tip, with the anal appendices stout, but hidden when viewed from above; cerci stout, conical.

Hab.—Sans Souci, Sydney (Mr. J. L. Bruce).

I have only one spirit specimen, but in perfect condition, taken by Mr. Bruce in the house flying to the lamp. It is somewhat like *Calotermes insularis*, White, in size and colour, but differs in having the head convex and not flattened in front, the smaller prothorax, neuration of wings and other important points.

CALOTERMES BROUNI, n.sp.

(Pl. XXXVI. figs. 1-1a.)

General colour dark reddish-brown, with the wings fuscous and the nervures chocolate-brown. Length to tip of wings 5, length to tip of body 3 lines.

Head longer than broad, rounded from the base to the front of the eyes, flattened on the summit and arcuate on the forehead. Eyes large, oval, not projecting very much, finely faceted; ocelli large, reniform, contiguous to the inner margin of the eyes. Antennæ springing from a cleft in front of the eyes; (?) 14-jointed; 1st joint large, cylindrical; 2nd and 3rd of equal length; 4th smallest; the rest broadly pyriform, more truncate on the apical edge towards the tip. Clypeus small; labrum large, quadrate, with the sides rounded in front; jaws stout, with two teeth at the tip, the others indistinct; palpi short and stout. Prothorax broad, truncate in front, slightly concave behind the head, sloping on the sides, slightly concave behind. Wings slender, more than thrice as long as broad; scapular shield large, with five branches, and one parallel vein running into the costal behind the second transverse from the subcostal; subcostal nervure sending out seven transverse nervures running into the costal, and irregularly forked at the tip; median nervure running parallel to subcostal, but merging into it before reaching the tip either in the last fork or the seventh transverse nervure of the subcostal, with three or four oblique irregular slender nervures turning downwards; submedian nervure with five thick oblique nervures at the base, and six slender ones all forked at the tips; the whole wing finely reticulated between the nervures. Legs short; thighs very thick; tibiæ short and stout, with the apical spines very large; terminal claws of the tarsi large; plantula small. Abdomen short, cylindrical, rounded at the tip, with stout conical cerci.

Soldier.—The head ochreous, more ferruginous towards the jaws; antennæ bright yellow, with the apex of the joints pale, the rest dull white. Length 3 lines. Head long, cylindrical, rounded

behind, nearly twice as long as broad, sloping down on the forehead, rugose behind the clypeus; antennæ 13-jointed, springing from a cleft on the sides of the head; 3rd joint shortest, the rest broadly pyriform, the last elongate-oval; clypeus small, truncate upon the sides; labrum large, rounded on the sides and tip; palpi slender, short; jaws broad and stout, curved and slender at the tips, with two angular teeth about the centre, rugose to a large angular tooth at the base; jaws crossing over each other to the centre; left jaw with only one tooth in the centre. Prothorax rounded on the sides, concave in front; abdomen elongate-oval; anal appendices long and hairy, cerci short and stout.

Worker with the head only pale yellow; length 2 lines. Head spherical; antennæ shorter and thicker than those of the soldier; thorax not quite as broad as the head; abdomen long, cylindrical, pointed at the apex.

Hab.—Drury, New Zealand (Captain Thomas Broun).

Spirit specimens of this species were sent to me by Captain Broun under the impression that it was *Calotermes australis*, White. It is, however, a very different form, differing both in size, colour, and other details. I am also indebted to Captain Broun for the following information:—"This species originally inhabited the 'Puriri' (*Vitex littoralis*) in our northern forests, where I have frequently cut out the nests containing only a small family. This species has been found in buildings as far south as Tauranga, and is widely distributed throughout the Auckland district even where the 'Puriri' does not grow. This is accounted for by the practice of using blocks of this wood for foundations sometimes infested with the termites; when they have eaten through the blocks they attack the kauri flooring boards, and in some cases eat their way through the wall studs to the roof. In the softer 'Wauri' timber the communities become much more numerous and destructive."

CALOTERMES ADAMSONI, n.sp.

(Pl. xxxv. figs. 2, 2a, 2b.)

Head ferruginous, thorax ochreous, with darker markings at the base of wings; upper surface of abdominal segments darker

ochreous; antennæ, legs, and all the under surface lighter coloured; wings pale fuscous with the nervures reddish-brown. Length $7\frac{1}{2}$ to tip of wings, 3 lines to tip of body.

Head broad, rounded behind, flat on summit, longer than broad, blackish and rugose along the front margin, with a small rounded pit in centre behind the clypeus. Eyes very small, round and standing out; ocelli wanting. Antennæ 16-jointed, antennal cleft deep; 1st joint large, broadest at apex; 2nd smaller; 3rd smallest; 4th 5th short; 6th-15th turbinate; 16th elongate-oval, smaller than the others. Clypeus small, pale yellow, truncate behind, rounded in front; labrum large, pale yellow, contracted at base, broad and rounded in front; jaws stout, with two sharp-pointed teeth at tip, and two large flat ones at base. Prothorax short, nearly as broad as the head, almost truncate in front, with a depression in the centre, rounded on sides, slightly arcuate behind, flattened on summit, with the edges slightly turned up; meso- and metathorax large, with a dark median suture, round at apical margin. Legs moderately long; thighs thick, short; tibiæ long, slender, with three stout spines at base; first three joints of tarsi short, 4th twice as long as the three others combined; claws large; plantula wanting. Wings large, slender, rounded at tips, thrice as long as broad; scapular shield small, round at base; tinted with ochreous yellow which extends slightly into the base of the wing; costal and subcostal nervures running parallel to each other and turning round the tip, a stout parallel nervure running out of the scapular shield and turning into the costal about the first quarter; four stout oblique nervures running upwards into the costal, with a network of more irregular shorter ones round the tips, forming irregular cells; median slender, running out towards the tip and branching out into three slender nervures turning downwards; submedian stout at base, slender beyond and turning downwards a little beyond the middle of the wings, with nine oblique nervures, the first six short and thickened, the whole wing covered with an irregular dainty network of nervelets; hind wing with the oblique nervures fewer than in the former, the median nervure running out to tip of wing, dividing into a single

fork, the submedian extending nearly the whole length of wing, with eleven oblique nervures, the 6th large and broadly furcate. Abdomen broad oval; cerci large, long and hairy.

Soldier.—Head bright reddish-brown, with front part and jaws black; antennæ and palpi dark reddish-brown at base of segment, giving them a variegated appearance; the rest of the body pale ochreous, with the legs rather darker. Head longer than broad, broadest at base contracting slightly behind the base of antennæ, flattened on the summit, a faint median suture with a transverse one turning down on either side into a raised knob above the antennal cleft; clypeus large, with a black protuberance on either margin; labrum contracted at base, rounded on sides, and turned downwards in front; antennæ more slender, and moniliform from the third joint to tip; palpi very long, extending nearly to the tip of jaws; jaws short and stout, slightly curved in at the tips, with three sharp incised teeth on the upper portion and one large one below; right jaw with one curved fang at tip, and a broad angular tooth below; prothorax more sharply rounded at tips, not as wide as the head, with median suture extending through it to base of metathorax; abdomen large, elongate-oval, narrowest at tip; cerci large; anal appendices large, close together, standing out perpendicularly.

Worker.—Head pale ochreous-yellow, with a dark ferruginous spot in front on either side of clypeus, the rest dirty white to pale yellow; length $4\frac{1}{2}$ lines; head large, orbiculate, as long as broad; abdomen large, cylindrical, rounded at tip.

Hab.—Uralla, N.S.W. (Mr. G. McD. Adamson).

This termite differs from the other members of the genus in having no ocelli, but the wings are so typical that I hesitate to remove the species from the genus *Calotermes*.

This species is rather common in the Uralla District, Mr. Adamson having sent me several families taken in December in dead stumps and logs, with the winged termites in their galleries. Of two different lots from different nests, one has the soldiers darker coloured and somewhat larger, but otherwise they agree.

Genus *TERMOPSIS*, Heer.

Heer, Insektenfauna von Oeningen, 1848.

Head large, rather oval, broadest behind and suborbiculate; eyes small, oval, not very prominent; ocelli wanting; antennæ long, 23-27-jointed. Prothorax small, not wider than the head, semicircular, flat. Legs long, robust, furnished with tibial spines and plantula. Wings as in *Calotermes*. Abdomen egg-shaped; anal appendages long, 6-jointed.

This genus contains three species described by Heer and Hagen from fossil specimens in Prussian amber; and two existing species, one from Manitoba and California, and the other from the west coast of South America.

Nothing particular is known about the habits of the existing species, but the genus is evidently closely allied to *Calotermes*.

Genus *PAROTERMES*, Scudder.

Proc. Amer. Acad. of Arts and Science, 1883.

This genus was formed by Scudder for the reception of three fossil species found in the American Tertiaries of Colorado, U.S. He says, "These species are most nearly allied to *Termopsis* and *Calotermes*, but differ from each of them in points wherein they differ from each other, and have some peculiarities of their own. They differ from *Calotermes* in their shorter wings (relative to the length of the body), which lack any fine reticulation, and in their want of ocelli. From *Termopsis* they differ in the slenderer but yet shorter wings without reticulation; their uniform scapular (subcostal ?) vein running parallel to the costa throughout, and provided with fewer and straight branches. From both they differ in the presence of distinct inferior branches to the scapular vein, but especially in the slight development of the intermedian vein and the median vein, the excessive area of the externomedian vein, and the course of the latter, which is approximated much more than usual to the scapular vein and emits branches having an unusually longitudinal course."

Genus MIXOTERMES, Sterzel.

This genus is founded upon the fossil wing of a termite from Lugau. From the description given of the wing it is probably allied to *Calotermes*.

Genus HODOTERMES, Hagen.

Bericht d. K. Akad. Berlin, 1853.

Head large, circular, with the median suture behind branching across towards the eyes; eyes oval, small, facets coarse, not projecting on the sides of the head; ocelli wanting: clypeus short, convex; labrum small, shell-shaped; antennæ a little longer than the head, 21-27-jointed; jaws short, powerful, toothed. Prothorax small, as large as the head, broader than long, saddle-shaped. Wings small, four times as long as broad, twice the length of the body. Tibiæ with five spines. Venation of the wings similar to that of *Calotermes*, broad from the base. Abdomen somewhat broader than the thorax, flattened on the dorsal surface; anal appendages cone-shaped.

In their habits the species resemble *Calotermes*. Seven species have been described from Africa; four fossil species from Europe and one from America. As yet I have found no Australian species of this genus.

The soldiers are remarkable for having true faceted eyes. Dr. Sharp has figured the soldiers of a remarkable species, *H. havi-landi*, from Africa, which move about in the sun without any protection.

Genus POROTERMES, Hagen.

Mon. Linn. Ent. xii. 1858.

Head smaller than that of *Hodotermes*; eyes small, facets fine; no ocelli; venation of the wings similar but much finer.

This is one of Hagen's subgenera, and was formed for three species from Chili, S. America.

Genus *STOLOTERMES*, Hagen.

Mon. Linn. Ent. xii. 1858, p. 105.

Allied to *Hodotermes*, but having only about half the number of joints in the antennæ. Ocelli present. Prothorax heart-shaped; first tarsal joint as long as those following. Venation of the wings as in *Hodotermes*, but the straight median nervure somewhat like that of *Eutermes*. Habits resembling *Calotermes*.

STOLOTERMES BRUNEICORNIS, Hagen.

Mon. Linn. Ent. xii. 1858, p. 105, Tab. ii. f. 5.

Dark brown; mouth parts, basal joints of antennæ, under surface of head and legs lighter coloured; wings fuscous, with the nervures a little darker; head and thorax smooth and shining; the whole insect rather long and thickly covered with hairs. Length to tip of wings $6\frac{1}{2}$, to tip of body 3 lines.

Head small, circular, sloping in front, with a distinct median suture, summit rugose. Eyes round, large; ocelli in front of the inner margin of the eye; a large indistinct central false ocellus-like spot. Antennæ 16-jointed; first two cylindrical, of equal length; the last oval, the rest cone-shaped. Clypeus small, short, labrum circular, mussel-shaped. Prothorax much smaller than head, broader than long, flat, rounded behind, contracted slightly in front. Wings long, four times as long as broad; scapular shield truncate, with five branches: costal and subcostal nervures connected by 7-9 very sharp transverse parallel nervures, sometimes forked; first two basal ones not springing from subcostal; median nervure running through the centre of the wing, with from 7-9 oblique nervures; submedian nervure very short, turned down, with four short thick nervures. Legs robust; thighs broad; tibiæ long, with two spines at the apex; tarsi one-third the length of the tibiæ, the last joint a little longer than the first three combined; plantula present. Abdomen broader than thorax, oval; cerci large, cone-shaped; anal appendices in the male long, slender.

Hab.—Tasmania.

The above description is compiled from Hagen, who states that he has seen three dried specimens in the Berlin Museum.

STOLOTERMES RUFICEPS, Brauer.

Reise Novara, Zool. Th., Neuroptera, p. 46.

(Pl. XXXVI. figs. 2-2a.)

General colour dark reddish-brown, the under surface much lighter, base of the joints of antennæ fuscous. Length to the tip of wings $5\frac{1}{2}$, to the tip of body $3\frac{1}{2}$ lines.

Head spherical; convex on the summit, rounded from the base to behind the eyes. Eyes large, projecting, coarsely faceted; ocelli wanting. Antennæ long, thickest towards the tips, 15-jointed, springing from cleft in front of the eyes; 1st and 2nd joints stout, cylindrical; 3rd very short; 4th-6th truncate at the extremities, narrowest at the base; 7th to tip broad oval; the last rounded at apex. Clypeus small, rounded in front; labrum large, broad, rounded at tip; palpi rather short; jaws large, stout, with three small rather blunt teeth near the tip and one similar some distance lower down, the base rounded. Prothorax narrow, not as broad as the head, broader than long, almost truncate in front, rounded on the sides, sloping to the hind margin, which is slightly arcuate in the centre, flattened on the summit, with a median suture running to base of abdomen, forming a dark line through the centre of the meso- and metathorax. Legs moderately long; thighs very stout; tibiæ long, slender, and cylindrical, with the tibial spines stout; tarsi long, claws large. Abdomen long, slender, cylindrical, broadest at the base, rounded at the apex; cerci short.

Soldier.—Head bright yellow, ferruginous towards the apex; jaws black, upper surface of the thorax brownish yellow, the rest dull white. Length $3\frac{1}{2}$ lines. Head longer than broad, rounded behind, flattened on the summit, straight on the sides, contracted from the antennal cleft to the base of the jaws, sloping down, and rugose upon the forehead: with very distinct faceted oval eyes upon the sides of the head behind the antennæ: antennæ springing

from a cleft in front of the head, 15-jointed, the basal joints as in the winged insect, with the apical joint stouter and not so stalked; clypeus small; labrum broadest at base, rounded on the sides to a rounded tip; jaws stout at the base, curved in at the tips, and crossing each other in the middle, with two broad angular teeth in the centre. Prothorax not as broad as the head, arcuate and broadest in front, rounded and sloping sharply on the sides to the apical margin; legs short; thighs very thick; tibiæ slender, with the two inner spines at base very close together; abdomen rather large, oval; cerci small.

Hab.—Drury, New Zealand (Captain T. Broun).

I have no workers in my collection, all other examples sent with the soldiers being pupæ with short wing-cases.

Spirit specimens of this species were sent to me by the Government Entomologist of New Zealand, but without any notes upon their habits.

The soldiers are remarkable for their distinctly faceted eyes, though some species of the *Hodotermes* group are also known to have soldiers provided with eyes. In an African termite (*Hodotermes havilanti*) which is figured in the Cambridge Natural History, and described as going about in the bright sunlight, similar eyes are very distinct.

RHINOTERMITINÆ.

Genus RHINOTERMES, Hagen.*

Head as broad as long; forehead flattened, with a parallel cleft through the centre of the rhinarium, which projects slightly in front, forming with the lobed clypeus a snout-like process. Eyes small, coarsely faceted; ocelli present, with a circular false ocellar spot in the base of the cleft: antennæ 20-jointed. Prothorax not as wide as the head, rounded in front. Legs stout, with two spines at the apex of the tibiæ; plantula wanting. Wings short and broad, rounded at the tips; scapular shield short and broad, swelling out and slightly convex at the cross suture; costal and subcostal nervures stout, well separated at the base,

slightly connected towards the tips with irregular cross veins; median nervure fine, but irregularly branched at the tip; submedian with a great number of fine bifurcated oblique nervures; the whole wing reticulated with furrows and ramulose veinlets.

Hagen placed in this subgenus of *Termes* three species from Cuba, Surinam, and Brazil. A fourth species was described by Brauer from Australia. The members of the Australian species live in communities like *Calotermes*. On account of the irregular veins between the costal and subcostal nervures I have placed them in a separate subfamily.

RHINOTERMES RETICULATUS, n.sp.

(Pl. XXXVI. figs. 3, 3a, 3b, 3c.)

Upper surface pale ferruginous, ventral surface pale yellow; wings light reddish-brown, semitransparent, nervures tawny. Length to tip of wings $5\frac{1}{2}$, to tip of body 3 lines.

Head slightly broader than long, broadest behind, sloping in on the sides in front of the eyes, and truncate across, rather flattened on the summit. Eyes small, not projecting, coarsely faceted; ocelli very small, in front of the eyes, elongate-oval. Antennæ 20-jointed, springing out of a deep antennal cleft; 1st joint large, cylindrical; 2nd about half the length; 4th the smallest; 5th-20th moniliform, increasing slightly in length, and more stalked to the tip; the terminal one round: all of them rather hairy. Clypeus large, truncate behind, divided by a deep cleft which proceeds from the front of the forehead where it commences in a small rounded spot in a line with the ocelli; labrum spade-shaped, rounded at the tip, longer than broad; jaws thick and stout, sharply curved in at the tip, with four sharp angular teeth, and a rounded edge at the base. Prothorax not as wide as the head, rounded in front, rotundate and depressed on apical margin. Legs robust, thighs short and broad; tibiæ long, slender, hairy, with two long spines at the tip; tarsi very spiny. Wings thrice as long as broad; scapular shield short, rounded above, with the suture slightly convex; costal and subcostal

nervures thick, running parallel to each other and curving round at the tip, without true cross veins, but with a number at the extreme tip forming irregular cells; median nervure slender, irregular, crossing the middle of the wing, turning downward and branching into three oblique forks, the first again bifurcated, the second simple and the last again forked; submedian running parallel with median to middle of wing, turning downwards, with eight oblique branching veinlets not always regular. Abdomen short, broad, rounded at the tip; cerci short and stout.

Soldier.—Head pale yellow, darkest towards jaws which are ferruginous; the rest dull white. Length 3 lines. Head large, short and broad, flattened on the summit, rounded on the sides, and sloping up in front from the deep antennal cleft to the base of jaws; forehead truncate, with a sharp canal cut out in the centre, forming a short gap with a circular spot or opening at the base: clypeus concave behind, rounded on the sides and narrowest in front; labrum very long, reaching to the tip of the closed jaws, broad at base, contracted towards the middle and swelling out into a rounded spatulate lobed tip; jaws short, stout, sharply turned over each other at the apex, with two sharp teeth below on the left fang and a single one on the right. Thorax smaller than head, with the prothorax more saddle-shaped than that of the winged ones; legs rather slender; abdomen short and broad, the slender anal appendices showing beyond the tip; cerci hairy.

Soldier (minor).—In this species a second form of soldier is always present in about equal numbers with the larger ones. In general structure they are similar, but with all the parts more slender and elongated; length 2 lines. Apical portion of head bright yellow, base much lighter: head broad at the base, sloping to base of the jaws, of a somewhat elongated pear-shape; jaws much elongated, slender, turning over at the tips; palpi nearly as long as jaws; antennæ 16-jointed; labrum very slender, but similar to that of the large soldier.

Worker dull white, lightly tinted with yellow behind the jaws; 2 lines in length. Head very large and broad, sloping round at

the jaws, with a curious bilobed pattern above the clypeus; antennæ very slender, 18- to 20-jointed; clypeus large, convex, rounded behind, with a deep median suture, a ferruginous spot on either side at the base of the antennæ; labrum small. Prothorax much smaller than the head, with a fine median suture running from the base through the meso- and metathorax; abdomen oval, swollen in the middle, broadly rounded at the tip.

Hab.: Kalgoorlie, W.A. (Mr. G. W. Froggatt; from nest); Palm Creek, Central Australia (Prof. Spencer, Horn Expedition).

Specimens of these termites were taken by my father in a dead sheoak (*Casuarina*) stump towards the end of March; and at this time the winged ones were more plentiful than the workers and soldiers. In their habits and general appearance they resemble *Calotermes*, and take the place of the eastern species, *R. intermedius*; both are plentiful in their districts.

RHINOTERMES INTERMEDIUS, Brauer.

Reise Novara, Zool. Th., Neuroptera, p. 49.

Upper surface pale ochreous, lighter coloured at the base of head and thoracic segments; under side, legs, and antennæ pale yellow; wings pale ferruginous, semitransparent, nervures darker. Length to tip of wings 7, to tip of body 4 lines.

Head similar to that of *R. reticulatus*, but with the eyes much larger and more prominent; ocelli larger. Antennæ very hairy, 20-jointed. Clypeus broader and not quite so convex. Prothorax broader and more deeply concave in front behind the head. Legs longer and tibiae more slender. Wings thrice as long as broad, larger, and lighter coloured, but with the venation identical.

Soldiers and *workers* as in the former species.

This species is not very common about Sydney. I found one small colony in the stem of a dead honeysuckle tree (*Banksia serrata*) near Sydney; but at Wallsend, near Newcastle, small colonies under dead logs are common, gnawing irregular passages

along the grain of the wood, and retreating into the log when disturbed. They are at once recognised by the large broad heads of the soldiers and the presence of two different forms of soldier.

The soldiers, like those of *Calotermes*, are very timid, never showing fight, but hurrying away to shelter when disturbed, the little soldiers being much the braver. I had never been able to find the winged forms in our nests, but my friend Mr. Gilbert Turner, of Mackay, was more fortunate, sending me down several winged ones with workers and soldiers.

Early last year Mr. N. Holtze sent me a small bottle full of winged ones that had been taken flying round the lamps at Palmerston, Pt. Darwin. This species was described by Brauer, the locality given being Sydney, N.S.W., but in a specimen sent from the Vienna Museum, where his types are, the label attached says, "Thorey, Cape York, 1868."

Hab.—Sydney and Newcastle, N.S.W. (W. W. Froggatt); Mackay, Queensland (Mr. G. Turner); Port Darwin, N.T. (Mr. N. Holtze, Botanic Gardens).

GLYPTOTERMITINÆ.

Genus GLYPTOTERMES, g.n.

Head broad; eyes moderately large, coarsely faceted; ocelli close to the eyes; antennæ short, 13- to 15-jointed, springing from a circular cleft in front of the eyes. Prothorax convex in front, rounded on the sides and convex behind, with a slight median suture. Legs stout and rather short, with short thick spines at apex of tarsi; plantula small. Wings slender, thrice as long as broad; scapular shield small and angular showing the base of four nervures: costal, subcostal and median nervures running close to each other through the upper half of wing, subcostal generally merging into the costal in the centre, but always separated at the extremities; submedian running through the centre of the wing; it and the oblique nervures often composed of fine dots.

Small dark-coloured termites, with clouded opaque wings, living in small communities in the trunks and bark of trees; soldiers very few; these and the workers slender and cylindrical.

GLYPTOTERMES TUBERCULATUS, n.sp.

(Pl. xxxv. figs. 9, 9a.)

General colour pale ochreous; legs and antennæ paler; wings vitreous, with the nervures fuscous at base and light ferruginous towards the tips. Length to tip of wings 6, to tip of body $2\frac{1}{2}$ lines.

Head broader than long, broad behind, almost quadrate, truncate in front, convex on the summit. Eyes standing out on the sides of the head, large and circular, coarsely faceted; ocelli round, in line with the apical margin of eyes. Antennæ short, rather hairy, springing out of a deep antennal cleft in front of the eyes, 15-jointed; 1st stout, cylindrical; 2nd and 3rd shorter, cylindrical, broadest at apex; 4th-14th short, broad, cup-shaped, rather broader towards the extremities, with the last joint oval. Clypeus rounded behind, produced into flanges on the side, narrower, truncate and quadrate in front; labrum broad, rounded in front, shell-shaped; jaws rather stout, with three sharp teeth at the tip; palpal joints very short and oval. Prothorax quadrate, slightly turned up on the edge, slightly concave in front, straight on the sides, truncated behind, with a depression in the centre and a slight suture, rough and flattened on summit. Legs short; thighs thick, rather cylindrical; tibiæ with three or four stout spines at apex; tarsi with the last joint very large; plantula present. Wings more than thrice as long as broad, rounded at tip, whitish when dry, very thin and easily torn; scapular shield narrow and angular, the cross suture truncate, the base of the first three nervures meeting on the upper edge, the lower submedian indistinct; costal, subcostal, and median nervures (the first strengthened at the extreme base by a short transverse parallel nervure running from the subcostal into the costal) running parallel and close together to the tip of wing; submedian nervure weak and irregular, running through the middle of the wing, without any stout oblique nervures at the base, but with

some 12 or 14 irregular nervures turning downwards: costal and subcostal of hindwings as in forewings, but with median emerging from subcostal at some distance from the scapular shield, and running parallel with it to the tips; the whole of the wings thickly covered with scars or pustules. Abdomen elongate-oval, slender; cerci short and stout, well under the abdomen; anal appendices wanting.

Soldier.—Head bright reddish-brown, jaws black, labrum luteous, prothorax ochreous, the rest dull yellow. Length 3 lines. Head a little longer than broad, cylindrical, sides straight, sloping in from behind the base of the antennæ to the centre where the forehead is deeply cleft, forming a rounded hollow with a stout knobbed protuberance on either side, and truncate below, and overhanging clypeus, which is small and indistinct; labrum large, flattened, spatulate, finely fringed with hairs; antennæ springing out of a circular pit in line with the base of jaws, 15-jointed; jaws short, ferruginous and very stout at the base, meeting at the tips, with two stout angular teeth below the tip on the left side, the jaw on the right side smooth to apex of labrum, where there is one large tooth. A stout cylindrical finger-like projection stands out on either side of the apical margin of head in front of the antennal cleft. Prothorax saddle-shaped, slightly arcuate in front, rounded on sides, and sloping back to apical edge which is slightly concave in the centre; a fine median suture running through the head and whole of the thorax; thorax and abdomen forming a cylindrical body, narrowing towards the tip, rather hairy; legs short and stout.

Worker about the same length and shape as the soldier, with the exception of the head, which is almost spherical; labrum quadrate; anal appendices very fine, slender, projecting beyond the tip of the abdomen; general colour dull white.

Hab —Uralla, N.S.W. (Mr. G. McD. Adamson).

Described from specimens received from the collector in spirits, and obtained by him in a log.

GLYPTOTERMES IRIDIPEXNIS, n.sp.

(Pl. XXXVI. figs. 5, 5a.)

Castaneous to piceous, antennæ and legs dark ochreous, the wings deeply clouded with pale reddish-brown, nervures reddish-brown. Length to tip of wings $5\frac{1}{2}$, to tip of body $2\frac{3}{4}$ lines.

Head longer than broad, widest behind, convex on the summit, and sloping down on forehead. Eyes small, round, rather coarsely faceted, on the sides of the head projecting very slightly; ocelli round, not contiguous but in line with centre of eye. Antennæ short, stout, and rather hairy, springing from a circular antennal cleft in front of eyes, 15-jointed; 1st stout, cylindrical; 2nd and 3rd smaller; the rest thickened, stout, pyriform; terminal joint oval. Clypeus large, quadrate; labrum convex on summit, broader than long, rounded in front. Prothorax rather broader than head, deeply concave in front, rotundate with the sides flanged and the apex rounded. Legs short, thighs broad and stout; tibiæ stout, cylindrical, broadest at the tips, with three short stout spines beautifully serrate on the edges; tarsi rather long, the terminal joint as long again as the first three combined, claws slender, plantula small. Wings slender, four times as long as broad, rather pointed at the tip; scapular shield long, narrow, with five nervures, cross suture transverse; costal nervure slender, with a stout, parallel, oblique nervure branching out of scapular shield and running up into costal; subcostal and median branching out together, the latter slightly angular, but running close together to the tip of wing; subcostal merging into costal about the middle of wing, but emerging again before the tip is reached; submedian branched on the scapular shield, with seven thick unbranched oblique nervures at the base, running through the centre of the wing, but slender and formed of fine spots like lace work, with five main similarly formed oblique nervures; the whole membrane of the wing thickly covered with fine tubercles, forming a network of irregular pattern. Abdomen short and stout, rounded behind; cerci small.

Hab.—Frankston, Victoria (Mr. W. Kershaw, National Museum).

This species is described from a single pinned specimen in good preservation; and is very distinct from any other species known to me.

GLYPTOTERMES BREVICORNIS, n.sp.

(Pl. XXXVI. figs. 6, 6a).

Upper surface pale ochreous; wings semitransparent, nervures brown tinged with yellow; under surface, legs, and antennæ stramineous. Length to tip of wings 5, to tip of body $2\frac{1}{2}$ lines.

Head a little longer than broad, rotundate, broadest between the eyes, rounded on the summit, with a slight median suture at the base. Eyes small, circular, not very prominent; ocelli oval, contiguous and in a line with the apical margin of the eyes. Antennæ 13-jointed, 1st joint large, cylindrical; 2nd shorter, cylindrical; 3rd-4th orbiculate; 5th-12th turbinate; the terminal one oval. Clypeus widest behind, narrow, truncate in front, sloping back on the sides; labrum broad, rounded on the sides, and rather truncated in front; jaws broad, with three short blunt teeth at apex, the edge roughened towards base. Prothorax not as broad as head, concave in front, rotundate on the sides and behind, with a slight depression at the apex, a dark median line running from the base through the meso- and metathorax. Legs short and thick, thighs large; tibiæ slender, armed with five stout spines at the apex; terminal joint of tarsi large; claws large; plantula small. Wings slender, twice as long as broad; scapular shield slender, rounded at the cross suture, clouded with fuscous extending into the base of the wing; costal, subcostal, and median nervures running parallel, close together, the last extending a little further round the tip of wing; submedian opaque at base, running through middle of wing, with three stout oblique nervures at the base, the apical one indistinct, about eleven in number, forming slender dotted nervelets turning downwards; the whole of the wings covered with minute spots

or scars. Abdomen broad, elongate, rounded at the tip; cerc short and stout.

Soldier.—Head pale ferruginous at base, becoming much darker towards the antennæ; jaws castaneous at base to black at tips; upper surface of thorax and legs pale ochreous, the rest dirty white. Length to tip of body $3\frac{1}{2}$ lines. Head twice as long as broad, rounded behind, straight upon the sides, broadest at base of jaws, flat on the summit and sloping down sharply in front, irregularly roughened; with a median suture dividing in front and running out on either side at base of antennæ; antennæ 13-jointed, short, not reaching beyond tip of jaws; clypeus small, flattened, slightly rounded in front; labrum almost quadrate, lying between the base of jaws, thin and shell-like; jaws very short, broad at the base, irregularly toothed, straight on the sides, curved at tip and just crossing each other, with three small angular teeth below on the left jaw and two larger ones on the right. Body long and cylindrical.

Worker.—Head and prothorax pale yellow, the rest white. Length to tip of body 3 lines. Head spherical, showing pale median and transverse sutures, and a dark mark along apical margin on either side in front of base of antennæ. Body long, cylindrical and rather hairy.

Hab.—Mackay, Queensland (Mr. Gilbert Turner).

GLYPTOTERMES EUCALYPTI, n.sp.

(Pl. xxxv. figs. 5-5a.)

The entire insect dark castaneous, antennæ ochreous, under surface somewhat lighter coloured; wings semi-opaque brown, nervures darker, covered with fine dots or scars iridescent in sunlight. Length to tip of wings $3\frac{1}{2}$, to tip of body $2\frac{1}{4}$ lines.

Head slightly longer than broad, broadly rounded at base, arcuate in front of eyes, rounded on summit, sloping down to clypeus. Eyes moderately large, projecting slightly; ocelli oval, contiguous to front margin of eyes. Antennæ 14-jointed, spring-

ing from an antennal cleft between the eyes; 1st joint stout, cylindrical; 2nd shorter; 3rd rather pear-shaped; 4th-13th larger, orbiculate, becoming more turbinate towards the tip; terminal one rounded. Clypeus broad and short, truncate behind, overlapping the broad bilobed labrum; jaws small, straight on the sides, with the tip curved in, a sharp tooth below, widely separated from the third. Prothorax nearly as broad as head, broader than long, concave in front, rotundate on the sides and slightly hollow behind, a slender median suture at base to the apex of metathorax. Legs short and thick; thighs broad, rounded; tibiae with three stout spines at apex. Wings slender, four times as long as broad; scapular shield small and slender, fuscous, the colour extending into the base of wings, the cross suture straight: base of subcostal in forewings robust, with a short nervure running out of scapular shield and turning up into costal just beyond the suture; costal and subcostal only separated from each other at the extremities; submedian stout at base, running through the middle of wing, with five or six opaque oblique nervures emerging from basal portion and six or seven finer and longer ones towards apex, all these more or less irregular from the many little dots covering the wings. Abdomen long, slender, rounded at tip; anal appendices very long and slender, close to the tip of abdomen; cerci short and stout.

Soldiers.—Head pale reddish-yellow, the rest white. Length $3\frac{1}{2}$ lines. Head longer than broad, rounded behind and straight on the sides, emarginate in front at the base of jaws, truncate on forehead and rugose above clypeus; median and transverse sutures distinct, the latter running out on either side to base of antennae; clypeus hidden; labrum broad, rounded in front and on sides, depressed in the centre and fringed with fine hairs; jaws very broad at base, short, rounded, turning over each other at the tips, with three sharp angular teeth. Abdomen long, slender, and cylindrical, tapering at the tip; cerci short and stout.

Worker of a general dull white colour; head faintly tinged with yellow; abdomen in life reddish-brown from the food eaten

showing through the semitransparent skin: head spherical, showing two lobes on forehead, rounded towards the base of antennæ, with a dark spot on either side of clypeus; prothorax smaller than head, the rest of thorax and abdominal segments rounded, slender, and cylindrical to the tip.

Hab.—Sydney, Botany and Hornsby (W. W. Froggatt).

About Sydney this species is only found by cutting off the loose bark upon the trunks of *Eucalyptus robusta*. The insects feed upon the inner bark, and sometimes on the living sap wood, evidently as a general rule gnawing a passage through from behind, as there are always several tunnels leading inwards in the trunks, which are nearly always rotten and decayed in the centre. They live in small communities of from fifty to a few hundred individuals, the majority being workers or larvæ, with sometimes only one or two soldiers in the colony. Except in the head, the soldiers closely resemble the workers, and try to hide as soon as they are exposed. They form very slender tubular tunnels in all directions in the bark, each individual burrowing on his own account, no room being left to allow of their passing each other. The winged ones are very small in comparison with the workers and soldiers. Some well developed pupæ were obtained in a rather numerous colony in a dead tree (the only time I ever found them away from the living trees), and these matured to the perfect insects in December.

HETEROTERMITINÆ.

HETEROTERMES, g.n.

Head large, longer than broad, nearly quadrate; eyes very small, not projecting; ocelli wanting; clypeus large; labrum broad; antennæ 16-jointed. Prothorax not as broad as head, truncated on the sides; legs stout, with four or five stout spines at the apex of tibiae. Wings nearly thrice as long as broad; scapular shield small and angular; costal, subcostal and median nervures running very close to each other, but the costal and subcostal distinctly separated from each other; submedian and oblique nervures slender.

HETEROTERMES PLATYCEPHALUS, n.sp.

(Pl. xxxv. fig. 10; Pl. xxxvi. fig. 4.)

General colour castaneous, legs brown, labrum ochreous; antennæ barred with white at the apex of each segment; wings pale fuscous with the nervures brown. Length to tip of wings 6, to tip of body $2\frac{1}{2}$ lines.

Head very large, longer than broad, almost quadrate, rounded behind and straight on the sides to well in front of the eyes, flattened upon the summit, slightly arcuate behind the clypeus. Eyes small, circular, well down on the sides of the head, not projecting; the ocelli wanting. Clypeus large, prominent, and rounded on the sides and apex, very slightly concave in front, with a median suture through the centre dividing it into two lobes; labrum broad, rounded in front. Antennæ 16-jointed, long, with large thickened segments, springing from in front of eyes; 1st joint long, cylindrical; 2nd and 3rd very small; 4th-15th increasing slightly in size towards the tip; terminal joint oval. Thorax covered with long scattered grey hairs; prothorax not as broad as head, truncated on the sides, rounded and arcuate in the centre of both base and apex. Legs short, robust; tibiae broad at tip, with four slender spines; tarsi slender. Wings nearly thrice as long as broad, rounded at the tip; scapular shield slender, hairy, angular, showing the base of four nervures; costal and subcostal nervures running very close together to tip; median nervure very fine, running close to subcostal, divided and turning down at the tip; submedian fine, with seven thickened oblique nervures; the first two very small; the 3rd, 4th, 6th, and 7th furcate, with four or five slender oblique apical nervelets. Abdomen short, elongate and oval at the tip.

Hab.—Kangaroo Island, S.A. (Mr. J. G. O. Tepper).

I have one mounted specimen from the Adelaide Museum. It is a very curious form differing from all other species in the long quadrate head and thick antennæ. There are also four specimens of this termite in the Macleay Museum, labelled South Australia.

EXPLANATION OF PLATES.

PLATE XXXV.

- Fig. 1. —Forewing of *Calotermes irregularis*, n.sp.
 Fig. 1a. —Hindwing of " "
 Fig. 1b. —Head of soldier of *Calotermes irregularis*, n.sp.
 Fig. 2. —Forewing of *Calotermes adamsoni*, n.sp.
 Fig. 2a. —Hindwing of " "
 Fig. 2b. —Head of soldier of *Calotermes adamsoni*, n.sp.
 Fig. 3. —Forewing of *Mastotermes darwiniensis*, n.sp.
 Fig. 3a. —Head of " "
 Fig. 4. —Forewing of *Calotermes insularis*, White.
 Fig. 5. —Forewing of *Glyptotermes eucalypti*, n.sp.
 Fig. 5a. —Head of soldier, " "
 Fig. 7. —Head of soldier, *Calotermes longiceps*, n.sp.
 Fig. 8. —Forewing of *Calotermes robustus*, n.sp.
 Fig. 9. —Forewing of *Glyptotermes tuberculatus*, n.sp.
 Fig. 9a. —Head of soldier, " "
 Fig. 10. —Head of *Heterotermes platycephalus*, n.sp.

PLATE XXXVI.

- Fig. 1. —Forewing of *Calotermes Browni*, n.sp.
 Fig. 1a. —Head of soldier, " "
 Fig. 2. —Forewing of *Stolotermes ruficeps*, Brauer.
 Fig. 2a. —Head of soldier, " "
 Fig. 3. —Forewing of *Rhinotermes reticulatus*, n.sp.
 Fig. 3a. —Jaw of " "
 Fig. 3b. —Head of soldier (major), *Rhinotermes reticulatus*, n.sp.
 Fig. 3c. —Head of soldier (minor), " "
 Fig. 4. —Forewing of *Heterotermes platycephalus*, n.sp.
 Fig. 5. —Head of *Glyptotermes iridipennis*, n.sp.
 Fig. 5a. —Wing of " "
 Fig. 6. —Wing of *Glyptotermes brevicornis*, n.sp.
 Fig. 6a. —Head of soldier, " "